



Modeling the impacts of global warming on predation and biotic resistance: Mosquitoes, damselflies and avian malaria in Hawaii

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Abstract:

Biotic resistance from native predators can play an important role in regulating or limiting exotic prey. We investigate how global warming potentially alters the strength and spatial extent of these predator-prey interactions in aquatic insect ecosystems. As a simple model system, we use rock pools in streams of rainforests of Hawaii, which contain the beautiful Hawaiian damselfly *Megalagrion calliphya* as predator and the invasive southern house mosquito *Culex quinquefasciatus* as prey. This abundant mosquito is the major vector of avian malaria transmission to native forest birds. We use mathematical modeling to evaluate the potential impacts of damselfly predation and temperature on mosquito population dynamics. We model this predator-prey system along an elevational gradient (749-1952 m elevation) and assess the effect of 1A degrees C and 2A degrees C climate warming scenarios as well as the effects of El Nio and La Nia oscillations, on predator-prey dynamics. Our results indicate that the strength of biotic resistance of native predators on invasive prey may decrease with increasing temperature because demographic rates of predator and prey are differentially affected by temperature. Future warming could therefore increase the abundance of invasive species by releasing them from predation pressure. If the invasive species is a disease vector, these shifts could increase the impact of disease on both humans and wildlife.

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Resource Description

Climate Scenario :

specification of climate scenario (set of assumptions about future states related to climate)

Other Climate Scenario

Other Climate Scenario: El Nino/La Nina-Southern Oscillation (ENSO) cycle; 1 and 2 degree C climate warming scenarios

Exposure :

weather or climate related pathway by which climate change affects health

Ecosystem Changes, Temperature

Temperature: Fluctuations

Geographic Feature:

Climate Change and Human Health Literature Portal

resource focuses on specific type of geography

Tropical

Geographic Location: ☒

resource focuses on specific location

United States

Health Impact: ☒

specification of health effect or disease related to climate change exposure

Infectious Disease

Infectious Disease: Vectorborne Disease

Vectorborne Disease: Mosquito-borne Disease

Mosquito-borne Disease: Malaria

Model/Methodology: ☒

type of model used or methodology development is a focus of resource

Other Projection Model/Methodology

Other Projection Model/Methodology: Mathematical models

Resource Type: ☒

format or standard characteristic of resource

Research Article

Timescale: ☒

time period studied

Short-Term (